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thousands of young lives were lost through its neglect. When we bow our heads before the Cenotaph we think of the highly trained men of science who were killed at Gallipoli or drowned in the mud of Flanders while Ministers turned for advice to alchemists and circlesquarers, or confused great chemists with dispensers of drugs, and we wonder whether even now anyone in power realizes what civilization has lost through the sacrifice of creators of knowledge. While we mourn their loss, let us work and pray for the scientific enlightenment of the leaders into whose hands the destinies of the nation are entrusted, so that we may be assured of strong and effective guidance whatever is before us.—*Nature*.

#### SCIENTIFIC BOOKS

*The Geology of South Australia.* By WALTER HOWCHIN, Lecturer in Geology and Paleontology in the University of Adelaide. Published by the Education Department, Adelaide, 1918. Pp. xvi + 543.

Division I. of this book is a general review of geologic processes and principles, with illustrations drawn chiefly from the geology of Australia. Incidentally, the illustrations bring out many facts concerning Australian geology, some of which are not readily available to the general reader. For example, in the discussion of deformation, it is stated that there are two belts of "settlement" (subsidence), one meridional, giving rise to the great rift valley, the ends of which make the present great gulfs, the other along the continental shelf at the south, running northwest and southeast, its location being about where the shallow sea floor slopes down to the depths. Settlement still is in progress in both these zones, and the earthquakes of Australia, of which two have been recorded in recent times, one in 1897, and one in 1902, are connected with the sinking.

Division II. of the volume deals with the historical geology of South Australia, but, fortunately, comprehensive notes are appended concerning the geology of other parts of the continent, so that this part of the book is a summary of Australian geology, with chief em-

phasis on South Australia. Brief correlation notes tie up the geology of the continent with that of England. The sections dealing with the Cambrian and the Permo-Carboniferous are perhaps of greatest interest because these systems have large and instructive representation in the continent. The Cretaceous also is represented in a large way.

The volume has excellent illustrations, both photographic and diagrammatic. The illustrations of Cambrian fossiliferous limestone, p. 377, are examples of the former, and the section of Mt. Remarkable, p. 279, of the latter.

The hope may be expressed that when a second edition of the book shall appear, a little more stress may be laid on the physical events in the history of the continent, as for example, the character, extent and dates of the principal deformations. If knowledge permits their preparation, paleographic maps would be most welcome. The volume is a very useful one, and adds much to our knowledge of the geology of the continent.

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#### SPECIAL ARTICLES

##### THE COMPRESSION OF A SOUND WAVE

LORD RAYLEIGH and more recently Professor A. G. Webster and others have given considerable attention to this problem. The following experiment, which is, I think, capable of exact development, is a further contribution.

1. *Apparatus*.—Many years ago<sup>1</sup> I showed that displacement interferometry lent itself favorably to the study of a diabatic expansion and this is particularly the case when the achromatic fringes are used. It is therefore suggested that the endeavor to look with the interferometer through the nodes of an organ pipe would not be unsuccessful.

Open pipes *P*, adapted for the purpose in question, are shown in Figs 2, 3. In Fig. 2, cylindrical adjutages *pp'*, of somewhat smaller diameter than the pipe (open within, but closed by glass plates *gg* on the outside) are

<sup>1</sup> Carnegie Pub. 149, Ch. XI., 1912.

introduced at the node  $N$ , symmetrically and at right angles to the pipe. The effect of this is to lower the pitch to a degree increasing with the length of  $p$ . If  $p$  is not too long, one may argue that the resilience of air at the node is decreased, and the period lengthened much in the same way in which an increased capacity operates in an electric circuit. The fundamental pitch was depressed about a fourth. The first overtone however occurred

Another available pipe is simply an open tube to be excited by resonance. This case is in a measure the most interesting of the three.

Finally the plan of quadratic interferometry is indicated in Fig. 1,  $L$  being a beam of white light from a collimator, with fine slit,<sup>2</sup>  $M, M', N, N'$ , the mirrors,  $N$  and  $M'$  half silvered and identically thick. Small fringes (1/10 mm. in the ocular) suffice. The

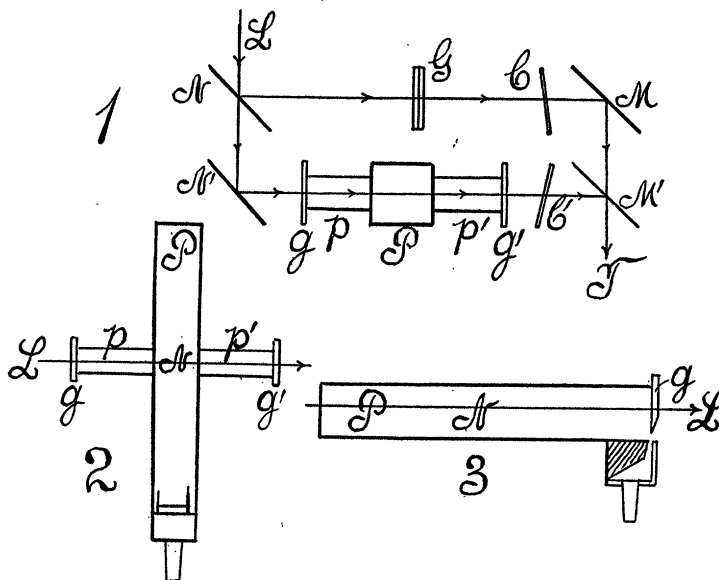


FIG. 1.

at about a tenth above this and came out very shrilly, probably because it coincided with the octave of the unchanged pipe. Moreover this first overtone is probably the fundamental of the small pipes  $p, p'$ . Thus this overtone here also presents two nodes of the same kind, both compressed and both rarified, and the optic effects (ray  $L$ ) are correspondingly intense.

The other form of pipe (shown in Fig. 3) has the plane of the embouchure at right angles to the axis of the pipe, which is closed at  $g$  by a knife-edged glass plate. The other end may be open, or closed with glass. The path of the interferometer beam is shown at  $L$ . Since the distribution of density is simple harmonic, the details are here quite open to computation.

pipe is in position at  $g p P p' g'$  and  $G$  is a glass compensator. In order that the fringes may be of any desirable size and at any inclination (horizontal preferable), two plate compensators  $C, C'$ , revolvable on vertical and horizontal axes, may be installed. If however the mirrors  $M', N'$  turn conveniently on horizontal axes, and  $M, N$  on vertical axes, the former may be used to give the fringes a horizontal trend and the latter, thereafter, for enlarging them.

When the pipe sounds sharply, the acromatic fringes necessarily vanish. Hence they

<sup>2</sup> The fringes at rest look like beads on a black string. There are about three colored fringes on either side of the middle one which is white.

must be observed at  $T$  by a *vibration tele-scope*,<sup>3</sup> in which case magnificent wave forms appear, measurable in amplitude.

2. *Observations.*—In the experiments, when the pipe  $P$ , Fig. 2, sounded its fundamental as softly as possible, the even horizontal band of fringes became definitely sinuous. Probably at the limit of audition there would be no response, except with much larger fringes. A strong fundamental makes the double amplitude about a fringe or more in width. The waves of the overtone are correspondingly shorter and high. The adjutages measured  $l=21$  cm. between plates. Reducing this to  $l=14$  cm. the fundamental came out much stronger, but the loud overtone gave a more confused record. Without adjutages the fundamental ( $l=5$  cm.) still evoked very marked waves, but the response of the shrill octave had naturally quite vanished. Moreover the form of the waves, obtained here without any mechanism but with the even harmonics deleted, is of additional interest.

3. *Deductions.* — Apart from details, I showed in the early paper<sup>4</sup> that for a length of tube  $l$  containing homogeneous air, the density increment  $\Delta\rho$  for the wave-length  $\lambda$  may be written  $\Delta\rho = (C/lR)n\lambda$ , where  $C=10^7 \times 1.27$  is the optic constant  $p_0(\mu_0 - 1)_0$  and  $n$  is the total fringe displacement. Hence if

$$l=20 \text{ cm.}, \lambda=6 \times 10^{-5} \text{ cm.}, \rho=.0013, \\ n=1/10, \Delta\rho/\rho=1.03 \times 10^{-3}$$

for the soft pipe note. Rayleigh considers  $d\rho/\rho=6 \times 10^{-9}$  just audible, so that my value is of a reasonable order, holding about  $2.4 \times 10^5$  times more energy per average cm.<sup>3</sup> ( $p \, d\rho/\rho=10^8$  ergs/cm.<sup>3</sup>) than Rayleigh's limiting note. For the shorter adjutages the main energy would be correspondingly larger. An open cylindrical resonator close to an equipitched open organ pipe can just be seen to respond. Blown at its edges by a lamella of air, however, strong waves antedate the first audible sibilation of pitch. Into the variety of inter-

esting stroboscopic effects I can not enter here.

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(Continued)

*A mosaic disease of cabbage as revealed by its nitrogen constituents:* S. L. JODIDI, S. C. MOULTON and K. S. MARKLEY. The cabbage disease investigated is characterized by denitrification taking place in the affected tissues, whereby the nitrates are in part reduced to ammonia which is lost as such, and in part to nitrites which reacting on the amino groups of the various organic compounds—acid amides, amino acids, etc.—bring about the elimination of elementary nitrogen. This is the reason why diseased cabbage tissues have a smaller proportion of total, nitrate, acid amide, diamino and monoamino nitrogen, nitrites occurring in diseased tissues only. Denitrification occurs in affected cabbage leaves in a very much higher degree than it does in the roots. There is a higher proportion of protein in the diseased cabbage tissues than in the normal. Loss of nitrogen in the affected cabbage tissues is in itself an explanation of the cabbage disease. Thus, *e.g.*, one of its conspicuous characteristics, the dwarfing of the plants, is easily understood when we bear in mind that the nitrogenous compounds such as acid amides, amino acids and others, which are partly lost through denitrification, are the very materials out of which the plant is building up its tissues. In the healthy cabbage samples the nitrogen is made up, in round figures, of 30 per cent. protein nitrogen, 7 per cent. diamino nitrogen, 10 per cent. mono-amino nitrogen, and 13 per cent. peptide nitrogen, which means that at least 13 per cent. of the nitrogen compounds present in cabbage have direct nutritive value.

*The influence of the diet of the cow upon the fat soluble and water soluble vitamins of cow's milk:* R. ADAMS DUTCHER, CORNELIA KENNEDY and C. H. ECKLES. Albino rats were fed purified diets containing casein, dextrin, agar, butter fat, wheat embryo extract and an adequate salt mixture. Varying quantities of winter milk and spring milk were fed with diets containing no added butter fat and with other diets containing no embryo extract. It was found that spring milk is superior growth-promoting properties with regard to both the fat soluble and the water soluble vitamins.

<sup>3</sup> Carnegie Publ. No. 249, III., Chap. V.; IV., Chap. VI., 1919.

<sup>4</sup> C. P., 149, p. 145.